CHARACTERISTICS ANALYSIS OF MATH ITEMS TYPE ON DATA TREND IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

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ABSTRACT

The study aims to explore the descriptive characteristics of the type of item in mathematics. The matter of the release of data derived from TIMSS 2011 Grade VIII consists of a content domain of numbers, algebra, geometry, and data and application opportunities and cognitive domains, knowledge, and reasoning. Item is composed of two types namely multiple choice and construk response. Multiple-choice assessment using the value one if true and zero if one constructs a response while using a value of two or one if absolutely perfect, one if the right part, and zero if false. The results showed as follows. First, about the multiple choice type favored Indonesian students than about the type of construct the response to all content domain and cognitive domain. Second, the cognitive domain knowledge is preferred over an application, it is preferable to the second reasoning type of item. Third, algebra least controlled by students, especially about the type of construct responses.

Keywords: TIMSS, constructs a response, multiple choice

INTRODUCTION

Indonesia has several times competing international level eg TIMSS (Trends in International Mathematic and Science Study). The competition is intended to measure the ability of Indonesian students in grade IV and VIII in mathematics and science. Implementation of the competition is conducted periodically four years, a special class VIII Indonesia already joined the race four times that of 1999, 2003, 2007, and 2011, while the 2015 TIMSS Indonesia did not join the competition for class VIII. The result of the acquisition during that time, Indonesia was among the lower in any.

The results of the competition in 1999 with 38 countries participating as attendees, Indonesia ranks top 35 in Chile, the Philippines, Morocco and South Africa. 2003 was followed by 46 countries, Indonesia was ranked 35 still unsatisfactory with a mean score of 411 below the international average score of 467. In 2007 followed 49 countries, Indonesia was ranked 36th with an average score of 397 below the average score International 500. Subsequently, year 2011 followed by the 42 countries of the acquisition value 386 below the international average score of 500 Indonesia is in a position in the top 38 Arab, Morocco, Oman and Ghana.

The study results Ariyadi (2016) revealed that all Indonesian students who participated TIMSS in 2011 there were 21% reached the low international benchmark score of 400, 5% reached intermediate international benchmark score of 475, 1% reached the high international benchmark score of 550, and 0% of Indonesian students reached the advanced international benchmark score of 625. results Puspendik report (2012) that the mathematics learning achievement of students of class VIII Indonesia according to the 2011 International benchmark that measures the dimensions of the content and the cognitive dimension is at a low level with a value of 389, compared with the results of the TIMSS 2003 there was a drop by 12 points. Mullis, et al., 2012 depicts a map of the position of Indonesia in the Asian countries (Singapore, Republic of Korea, Japan,

Malaysia, and Thailand) in TIMSS, Indonesia is on the bottom both in terms of material (number, algebra, geometry and measurement, as well as data and opportunities as well as in terms of the cognitive aspects of knowledge, application and reasoning.

The downgrade these achievements can be caused by psychometric ability level than about the wider type characteristics in which the ability is too low, while the characteristics of the type of item in the form of the higher difficulty levels on each dimension and complex content and cognitive dimensions. Special TIMSS 2011, Mullis, et al., (2009) reveals there are four dimension of content that is 20% number, 30% fraction, 30% algebra, and 20% of data and opportunities while the cognitive dimension is divided into three which is 35% knowledge (knowing), 40% application (applying), and 30% of reasoning (reasoning). While the matter is composed of two types, namely multiple choice (multiple-choice) and construct responses (constructed-response). Ratings for multiple-choice items worth one if true and 0 if false, while to the constructed-response items are generally worth one or two points, depending on the nature of the tasks and skills required in solving them.

If the acceleration of difficulty of an item is higher than the acceleration capability then the data will not change significantly even reverse the widening can occur so the achievement is getting more bleak. Data characteristic of the type of questions yet to be revealed scientifically particular characteristics of the types of math problems. Therefore, the need to study the characteristics of TIMSS descriptive type of questions to obtain information about the location of the student's ability in terms of both material and cognitive domains in math class VIII.

Trends In International Mathematics And Science Study

Trends in International Mathematics and Science Study (TIMSS) is a four-yearly competition organized by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS is the development of The Third International Mathematics and Science Study, which was held in 1995 and attended by more than 40 countries. TIMSS 1995 measures the ability of students in the fifth grade, namely (grade 3, grade 4, grade 7, grade 8, and the last class of secondary education). Prior to the 1995 TIMSS previously The First International Mathematics Study (FIMS) in 1964 with 12 countries participating and The Second International Mathematics Study (SIMS) held in 1980-1982 and followed by 20 participating countries.

TIMSS mathematics test on cover-dimensional content and cognitive dimensions are compiled in a comprehensive manner. TIMSS content on different dimensions for grade 4 and grade 8 to grade 4 dimensional content includes numbers (50%), geometric shapes and measurements (35%), and presentation (15%). The content dimension to grade 8 includes the number (30%), algebra (30%), geometry (20%), as well as data and opportunities (20%). Although tests for grade 4 and grade 8 have some differences on the dimensions of the content, but for the cognitive dimension of these two classes together, which includes knowing, applying, and reasoning (Mullis et al., 2009). The realm of knowledge includes facts, concepts, and procedures that need to know the students. The characteristics of matter in the realm of knowledge is related to the concept of recall, recognize, classify and order, compute and measure. The sphere of application of the focus on the student's ability to apply knowledge and conceptual understanding to solve various Items. Item in the realm of reasoning with regard to the determination of strategies / tools are

efficient or determine, modeling or presenting Items in a model / represent), and the implementation of strategies to solve items implement. The realm of reasoning include Item solving that is not routine, complex context and Item solution with tiered steps (multi-step Item). Item in the realm of reasoning asks students to analyze, synthesize, evaluate, conclusions draw, generalize, and justify. Although the TIMSS test grade 4 and grade 8 includes cognitive dimensions are the same, but the distribution of each different cognitive domains. Tests for grades 4 covers 40% knowledge, 40% of application, and 20% of reasoning. To grade 8 includes 35% knowledge, 40% of application, and 25% of reasoning.

Item used in TIMSS consists of multiple choice item, short entries, and essays. Scores on the multiple choice item and short field is one for correct answers and 0 for a wrong answer or not answer. Scores for about 2 to answer the description is correct and complete, 1 for true but incomplete answer, and 0 for a wrong answer or not answer. From the context, using two forms which is about the real-world context (contextual question) and about the form of formal mathematics.

TIMSS International Benchmark

Peers or benchmarks on TIMSS 2011 can be divided into three categories, namely advanced, high, intermediate and low. The benchmarks for each category of advanced or advanced international benchmark for students who achieve a score of 625, a high-level or high international benchmarks with the boundary score of 550, a mid-level or intermediate international benchmark with the boundary score of 475, and a low level or low international benchmark for students who achieve a score of 400 (Mullis et al., 2012). The description for the four benchmarks are presented in Table 1.

Table 1. TIMSS International Benchmark

Kategori	Class	
International Benchmark	IV	VIII
Advanced	Applying understanding in complex situations and provide reasoning over a given solution	Reasoned, draw conclusions, make generalizations, and solve linear equations.
High	Applying knowledge and understanding to solve problems	Applying knowledge and understanding in a variety of complex situations
Intermediate	Applying basic knowledge in simple situations (*straightforward*)	Applying basic knowledge in various situations or contexts different
Low	Master some basic knowledge of mathematics	Master some basic knowledge of integer and decimal, number operations, and basic graphics

RESEARCH METHODS

Methods/Design Research

Descriptive exploratory study using methods that describe the characteristics of the type of math Item. The method used to assess the characteristics of the type of item that have been released by the TIMSS 2011.

Object of research

The object of research is the type of test TIMSS in mathematics class VIII comprises domain content number, algebra, geometry, and data and data and chance by taking into account cognitive domains that applying, knowing, and reasoning. Item is composed of two types of multiple choice item and constructs the response. Multiple-choice assessment using the value one if true and zero if one constructs a response while using a value two if absolutely perfect, one if the right part, and zero if false.

Data Research

This study uses data documentation guided and TIMSS 2011. Data is copied from the TIMSS 2011 Eighth Grade Almanacs and TIMSS 2011 Released Items with Percent Correct Statistic - Eighth Grade.

Stages of Data Analysis

Data analysis using Excel program with the following steps. First, data retrieval 2011. Both TIMSS mathematics, math checks on all domain content and topic area with attention to the cognitive domain and

the number of test takers. The inspection analysis and data IDBAnalyser codebook. Third, analyzed descriptively using Excel program.

RESULTS AND DISCUSSION

1. Description of Content and Cognitive Domains

Table 2. Number of Item on the Content and Cognitive Domains

Content Domain	Topic Discussion	Item number on the Cognitive Domain			Σ
		Know	Appli	Reas	
Number	Real Number	1	2	1	4
	Fraction and Decimal	8	3	1	12
	Ratio, Proportion, Percent	1	1	0	2
	Integer	0	0	1	1
Algebra	Pattern	0	1	7	8
	Algebra Expressions	8	2	1	11
	Equations/Formulas and Functions	6	3	1	10
Geometry	Geometric Shapes	3	2	6	11
	Location and Movement	2	1	0	3
	Geometric Size	0	5	1	6
Data and Chance	Data Interpretation	0	2	4	6
	Change	2	3	1	6
	Organization and Representation Data	1	1	0	2
	Σ	34	30	24	88

The number of math items released is not the same in each content domain and cognitive domian. Cognitive domains, the number of item are most numerous in knowledge as much as 34, as many as 30 applications, then reasoning as many as 24. Domain content, the amount of matter the most to the algebra that is 29 whereas the number of item, at least at the data and the opportunity 14. If specified in the topic discussion of the fractions and decimals at most the 12 item while the integer of at least 1. Table 2 shows the amount of matter in the cognitive domains and domain content.

2. Description Average Probability of Each Type of Problem in Topic Area

The mean probability of correct Indonesian students respond to item of type multiple choice item about the type of higher than construct a response. The value of these two tasks is almost twice the 34:18. This applies to all content domain numbers, data and opportunities, algebra, and geometry. Likewise, on all topics except the area of geometry measurement difference is not too large: the average probability of correct multiple-choice 25 while the average probability of correctly constructs response 20.3.

Table 3. Average Probability Correct Item Each on Topic Area

Content Domain	Area Topic	Probability Average True Each Type of Item		μ
		MC	CR	
Number	Integer	0	4	
	Fractions and Decimal	37.3	0	
	Real Number	41	15.5	
	Ratio, Proportion, Percent	36	20	25.633
Data and Chance	Data Interpretation	31	14.667	
	Chance	29	0	27.917
	Organization and Respresentation Data	0	37	
Algebra	Pattern	51	16.5	
	Algebraic Expressions	36	5.5	25.142
	Equation/Formulas and Function	29.25	12.6	
Geometry	Geometric Shapes	33.5	26	
	Geometry Size	25	20.333	
	Location and Movement	35.5	18	26.389
	μ	34	18	

3. Description of Item Types and Cognitive Domain

Type MC item had a mean probability of actually larger than the item response constructs while kogntif dimensions larger than the application of knowledge and reasoning and the application is greater than understanding. All types of cognitive dimensions MC item greater than average probability of correct responses constructs item.

Table 4. Proportion Average True Type and Dimension Cognitive Items

Dimension Cognitive	Item Type		Average
	MC	CR	
Knowing	38.95455	23.58333	31.26894
Applying	29.72222	19.25	24.48611
Reasoning	29.375	12.6875	21.03125
Average	32.68392	18.50694	-

DISCUSSION

Indonesian students' ability to answer correctly a question of a selected sample compared TIMSS 2011 participant countries are under international average even at lower levels of the state under the average inernasional. This type of Item is the type of multiple choice item correctly highest average probilitas than the type of response that construct matter nearly doubled regardless of domain content and topic areas.

All cognitive domains highest type of multiple-choice type of item rather than construct a response. The most striking difference in the cognitive domain of reasoning correctly that the average probability of 30 on the multiple choice responses while the average probability of correct construct only 19. The mean probability of correctly highest on the cognitive domain of knowledge and the continued application of reasoning. It shows Indonesian students are better able to work on multiple choice item rather than a matter construct a response on all domain content and topic areas. Likewise, in terms of the cognitive domain Indonesian students more easily work on the Items of type of knowledge (C1) of the application (C3) and (C4-C6). C4-C6 (reasoning) is the most difficult kind of cognitive domains in multiple-choice type item all the more a matter of the type of construct responses. The findings were in line with the habits of the students working on the Items of type multiple choice than either type of exam descriptions about the school and national level exams. The results of the study Ariyadi et al. (2015) showed that teachers tend to tell the students about the mathematical concepts needed to solve the contextual style expository method is not the method of the invention.

In addition, the way teachers behave towards mathematics and the ability of teachers to understand and transfer knowledge to students, for example the lecture method would affect the ability of students. According to the Human Development Department East Asia and Pacific Region (2010) that the capabilities and performance of teachers could have an effect on the ability of the students but for the most teachers taught using expository method so that absorption is less meaningful. Further Wilkins (2008) suggests that the outlook or beliefs of teachers of mathematics influenced the way teachers teach. It directs how to make a judgment including the types of assessment. This type of assessment is common to it is the type of multiple choice item categorized domain knowledge. The results of the research report Mullis, et al. (2012) shows the percentage of correct answers students' Indonesia is far below neighboring countries about the real-world context.

Item in Figure 1, a matter of the domain of application of the percentage of correct answers. Indonesia to get the percentage of correct answers 28% while Singapore 85%, Thailand 45%, and Malaysia 50%, and 47% International

Sport	Number of Students
Hockey	60
Football	180
Tennis	120
Basketball	120

480 students were asked to name their favorite sport. The results are shown in this table.

Use the information in the table to complete and label this pie chart.

Figure 1. Item Context Real World

Special math formal shape, Indonesia increased enough prosenstase correct answer but neighboring countries be increased so that it remains at the bottom. Item in Figure 2, a matter of cognitive domain knowledge of the percentage of correct answers Indonesia only 57% while Singapore 94 %%, Thailand 64% and 91% while Malaysia International 72%.

$$42.65 + 5.748 =$$

Figure 2. Item formal mathematical form

Therefore, habituation items of type kontsruk response similar to the type of item descriptions reveal the situation of the real context as a matter of type of High Order Thinking Skills (HOTS) is supported by the learning environment of students which is a method of teaching a teacher is a way for students Indonesia can compete with the participating countries TIMSS,

CONCLUSION

Item type multiple choice favored Indonesian students than about the type of construct the response to all content domain and cognitive domain. Indonesia prefers students about the cognitive domain of knowledge rather than applications. Furthermore, Indonesian students prefer the matter to the application domain rather than reasoning.

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